

CASE REPORT

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# Intravascular large B-cell lymphoma appearance on dual-energy computed tomography: a case report

Daisuke Yamada<sup>1\*</sup>, Ryosuke Imai<sup>2</sup>, Masaki Matsusako<sup>1</sup> and Yasuyuki Kurihara<sup>1</sup>

## Abstract

**Background** Intravascular large B-cell lymphoma (IVLBCL) is the proliferation of neoplastic B lymphocytes in the vascular space. Since conventional computed tomography (CT) shows nonspecific findings, differentiation between IVLBCL and other lung diseases, such as diffuse interstitial lung disease, is difficult.

**Case presentation** A 73-year-old man presented with dyspnea and hypoxemia. Laboratory findings showed an increased lactate dehydrogenase level of 1690 U/L (normal: 130–235 U/L) and soluble interleukin-2 receptor level of 1140 U/mL (normal: 157–474 U/mL). Dual-energy CT iodine mapping showed a significant symmetrical decrease in iodine distribution in the upper lungs, suggesting an unusual distribution of pulmonary hypoperfusion. Therefore, IVLBCL was suspected. A random skin biopsy confirmed the diagnosis of IVLBCL. Due to the severity of the disease, lung biopsy was averted. After admission to the hospital, high-dose methotrexate was administered for central nervous system involvement, due to findings of suspected intracranial infiltration on a brain magnetic resonance imaging and elevated cell counts on lumbar puncture. Subsequently, oxygen demand improved, and rituximab along with cyclophosphamide, doxorubicin, vincristine, and prednisone was added to the patient's regime. Eventually, oxygen administration was terminated, the patient's general condition improved, and the patient was discharged after 47 days of hospitalization.

**Conclusions** Since the diagnosis of IVLBCL depends on whether it is possible to suspect IVLBCL, the finding of decreased iodine perfusion demonstrated on dual-energy CT is considered important information for diagnosis. An immediate diagnosis of IVLBCL is needed to avoid rapid disease progression and introduce early treatment for a favorable prognosis. In this case, unique pulmonary hypoperfusion demonstrated by dual-energy CT promoted early diagnosis of IVLBCL.

**Keywords** IVLBCL, Dual-energy CT, Pulmonary hypoperfusion, Hypoxemia, Iodine mapping

## Background

Intravascular large B-cell lymphoma (IVLBCL) of lung is a rare type of extranodal large B-cell lymphoma (LBCL) characterized by the selective growth of lymphoma cells within the lumina of vessels, particularly within capillaries, with sparing of larger arteries and veins. Conventional CT scans only present nonspecific imaging findings for IVLBCL. However, we present a case in which the newly developed dual-energy CT provided support for the diagnosis of IVLBCL.

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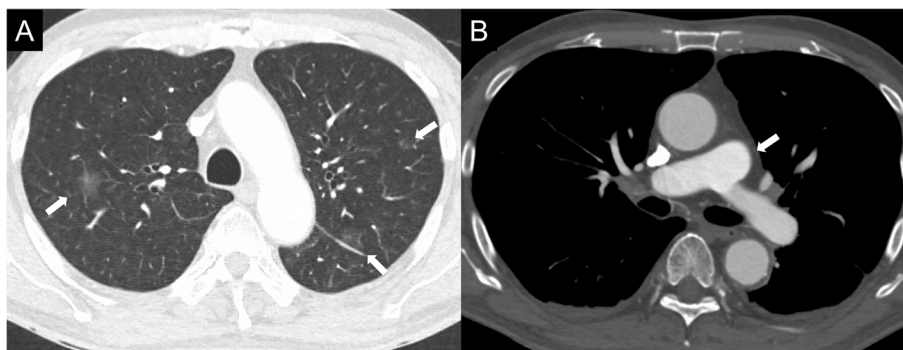


### Case presentation

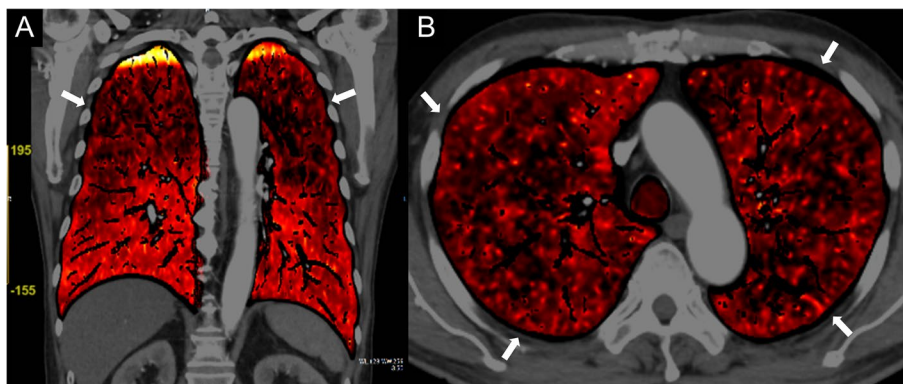
A 73-year-old man presented with dyspnea and hypoxemia. The patient was admitted to our hospital because he had been experiencing dyspnea for the past 2 weeks at rest as well as during exertion. He had no history of smoking. On physical examination, the patient had a body temperature of 36.7 °C, blood pressure of 151/89 mmHg, heart rate of 122 beats/min, respiratory rate of 21 breaths/min, and oxygen saturation of the peripheral artery of 88% (room air). On auscultation, no heart murmur was heard and lung sounds were clear. Laboratory findings showed an increased lactate dehydrogenase (LDH) level of 1690 U/L (normal: 130–235 U/L) and soluble interleukin-2 receptor (sIL-2R) level of 1140 U/mL (normal: 157–474U/mL). We initially suspected pulmonary artery thromboembolism. Therefore, we performed a dual-energy Computed tomography (CT) scan, including the pulmonary artery phase. CT showed patchy ground-glass opacities predominantly in both upper lobes of the bilateral lungs (Fig. 1A). The

pulmonary artery phase of CT showed no dilatation of the main pulmonary artery trunk diameter and no contrast defects within the pulmonary arteries (Fig. 1B). Dual-energy CT iodine mapping showed a significant symmetrical decrease in iodine distribution in the upper lungs, suggesting an unusual distribution of pulmonary hypoperfusion (Fig. 2).

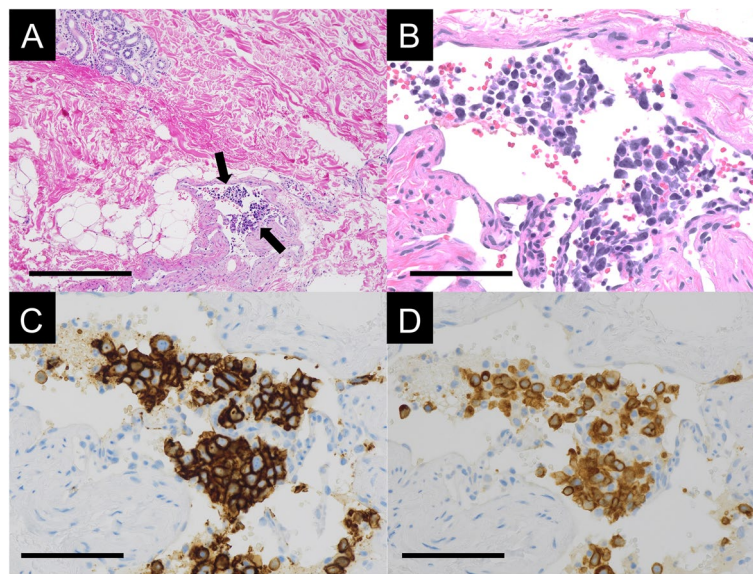
We suspected intravascular large B-cell lymphoma (IVLBCL) based on the patient's history of dyspnea for the past 2 weeks with no history of cancer, decreased peripheral perfusion of the lung parenchyma on CT, and elevated LDH and sIL-2R levels on laboratory findings. Three days after admission, a random skin biopsy was performed. Atypical cells were present from the dermis to subcutaneous vessels, leading to the suspicion of lymphoma. Immunostaining showed that the atypical cells were CD5+, CD20+, CD79a+, CD3-, and CD30- (Fig. 3); therefore, the diagnosis of IVLBCL was confirmed. Due to the severity of the disease, lung biopsy was averted.



**Fig. 1** Chest computed tomography images. **A** Chest computed tomography (CT) shows patchy ground-glass opacities predominantly in both upper lobes of the bilateral lungs (arrows). **B** The pulmonary artery phase of the CT shows no dilatation of the main pulmonary artery trunk diameter and no contrast defects within the pulmonary arteries (arrow)



**Fig. 2** Dual-energy computed tomography images. **A, B** A color-coded iodine mapping image from the dual-energy CT shows decreased pulmonary perfusion in the upper lungs (arrows). The symmetrical, upper-lung dominant hypoperfusion was unusual for pulmonary thromboembolism and probably resulted from small vessel obstructive disease due to intravascular large B-cell lymphoma. The small yellow regions observed in the bilateral apices are attributable to hard beam artifact and do not imply high iodine concentration



**Fig. 3** Histological images of a random skin biopsy specimen. **A, B** Hematoxylin and eosin stain (A: scale bar, 400  $\mu$ m; B: scale bar, 200  $\mu$ m) reveal a blood vessel filled with atypical lymphocytes (arrows). **C** Immunostaining shows CD20-positive lymphocytes within the vessel (scale bar, 100  $\mu$ m). **D** Immunostaining shows CD79a-positive lymphocytes within the vessel (scale bar, 100  $\mu$ m)

After admission to the hospital, high-dose methotrexate was administered for central nervous system involvement based on the findings of suspected intracranial infiltration on a brain magnetic resonance imaging and elevated cell counts on lumbar puncture. Subsequently, oxygen demand improved, and rituximab along with cyclophosphamide, doxorubicin, vincristine, and prednisone was added to the patient's regime. Eventually, oxygen administration was terminated, the patient's general condition improved, and the patient was discharged after 47 days of hospitalization.

### Discussion and conclusions

IVLBCL is the proliferation of neoplastic B lymphocytes in the vascular space. It is characterized by vascular obstruction of various organs. The diagnosis of IVLBCL before death is often difficult because of the diverse clinical presentation. When the lungs are involved, patients develop dyspnea, hypoxemia, and rarely pulmonary hypertension [1]. Since conventional CT shows nonspecific findings, differentiation of the lesions from other lung diseases, such as diffuse interstitial lung disease, is difficult [2]. Pulmonary perfusion scintigraphy shows diffuse peripheral circulatory disturbances in cases of IVLBCL [3]. However, perfusion scintigraphy is difficult to perform promptly due to the time required for nuclide preparation. Iodine mapping by dual-energy CT is useful for evaluation of pulmonary perfusion defects, with good agreement with lung perfusion scintigraphy [4]. This technique produces an iodine-specific image

based on two CT datasets acquired with different X-ray spectra. On a color-coded iodine mapping image, the brighter-colored areas indicate a higher concentration of iodine (normal perfusion), and the darker-colored areas indicate a lower concentration of iodine (hypoperfusion area). Diffuse circulatory disturbances in the peripheral lung parenchyma of IVLBCL can be demonstrated by dual-energy CT as decreased iodine perfusion. Dual-energy CT is a simple and rapid procedure. Diffuse hypoperfusion of iodine on dual-energy CT can also be seen in other diseases that diffusely involve peripheral blood vessels in the lung parenchyma, such as pulmonary tumor thrombotic microangiopathy [5]. Nevertheless, since the diagnosis of IVLBCL depends on the suspicion of IVLBCL, the finding of decreased iodine perfusion demonstrated on dual-energy CT is considered important information for diagnosis. An immediate diagnosis of IVLBCL is needed to avoid rapid disease progression and introduce early treatment for a favorable prognosis. In this case, unique pulmonary hypoperfusion demonstrated by dual-energy CT promoted early diagnosis of IVLBCL.

### Abbreviations

|        |                                     |
|--------|-------------------------------------|
| IVLBCL | Intravascular large B-cell lymphoma |
| CT     | Computed tomography                 |
| LDH    | Lactate dehydrogenase               |
| sIL-2R | Soluble interleukin-2 receptor      |

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### Authors' contributions

All authors have read and approved the manuscript, and significantly contributed to this paper. DY, MM, RI, YK: Conception and design, literature review, manuscript writing and correction, and final approval of the manuscript.

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### Availability of data and materials

Data sharing is not applicable to this report as no datasets were generated or analyzed during the current study.

### Declarations

#### Ethics approval and consent to participate

Appropriate written informed consent was obtained from the patient for the publication of this case report and accompanying images. This report was approved by the Clinical Research Ethics Committee of St. Luke's International Hospital (Approval Number 21-R150).

#### Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

#### Competing interests

The authors declare that they have no competing interests. This manuscript has not been published and is not under consideration for publication elsewhere. Additionally, all the authors have approved the contents of this paper and have agreed to the journal's submission policies.

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### References

1. Yousem SA, Colby TV. Intravascular lymphomatosis presenting in the lung. *Cancer*. 1990;65(2):349–53.
2. Cha MJ, Lee KS, Hwang HS, et al. Pulmonary intravascular lymphomatosis: Clinical, CT, and PET findings, correlation of CT and pathologic results, and survival outcome. *Radiol*. 2018;280:602–10.
3. Curtis JL, Warnock ML, Conrad DJ, Helfend LK, Boushey HA. Intravascular (angiotropic) large-cell lymphoma ('malignant angioendotheliomatosis') with small vessel pulmonary vascular obstruction and hypercalcemia. *West J Med*. 1991;155(1):72–6.
4. Thieme SF, Becker CR, Hacker M, Nikolaou K, Reiser MF, Johnson TR. Dual energy CT for the assessment of lung perfusion—correlation to scintigraphy. *Eur J Radiol*. 2008;68(3):369–74.
5. Yamada D, Murakami M, Matsusako M, Tamura T, Kurihara Y. Pulmonary tumor thrombotic microangiopathy appearance on dual-energy computed tomography. *Am J Respir Crit Care Med*. 2021;203(6):759–60.

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